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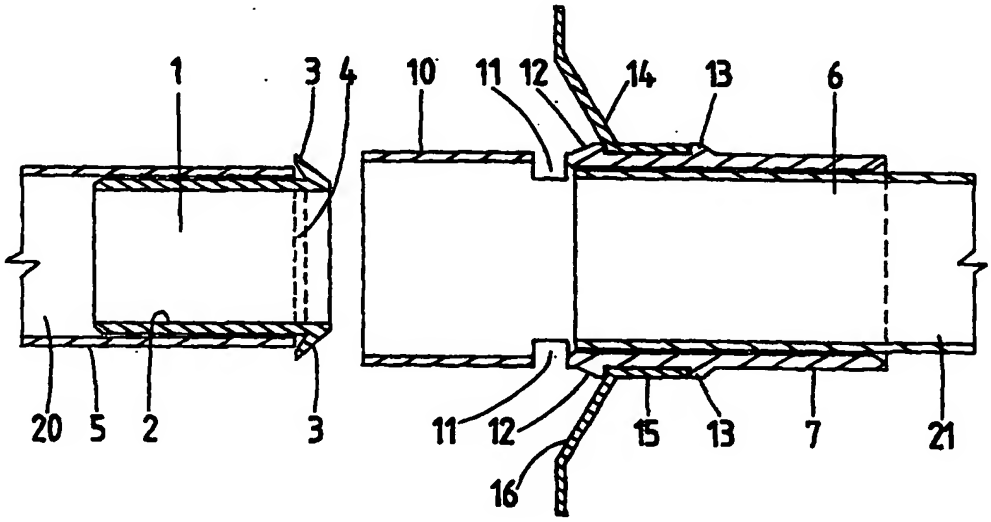


(57) Abstract

A cartridged explosive charge wherein said cartridged explosive charge comprises a shell which defines a chamber filled with explosive charge, said cartridged explosive charge further comprises a first connector means and a second connector means positioned at opposite ends of the shell wherein said first connector means comprises at least one lateral projection and said second connector means comprises a recess adapted to receive a lateral projection on a first connector means of a second cartridge so as to retain the second cartridge substantially coaxial with, and adjacent to, the first mentioned cartridge.

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# CARTRIDGED EXPLOSIVES

The present invention relates to loading blastholes in civilian blasting operations. More particularly, the present invention relates to connectors and a method for connecting together cartridges of explosive for loading in a blasthole.

Before commencing an above ground or an underground blast, the blastholes must be drilled in a predetermined pattern, that is, in particular positions and depths. The pattern is often difficult to calculate because of an enormous number of variables which must be taken into account including, the type of rock, geological characteristics of the blast area, the amount of rock breakage desired, the resultant fracture pattern required and so forth. The blast pattern must be matched to the type, amount and power of explosive used. In very large blasts, many hundreds of blastholes may be detonated in carefully predetermined sequences.

Optimally, relatively smooth, cohesive faces or walls of rock will be created as a result of the blast. The face of the rock remaining will ideally follow the contour of the final blastholes detonated in the blast.

For example, in above-ground mining operations, quarries or mines often comprise a vertical wall (like a cliff face) of nominally 10 to 18 metres, behind which is the rock to be blasted. The upper surface of the rock is called the mine bench. Prior to a blast, vertical (or near vertical) blastholes are drilled in the bench. The pattern often comprises numerous rows of blastholes which are detonated in sequence. The row closest to the face is detonated first, followed sequentially by the rows behind. It is desirable for the blast to provide a new, smooth, vertical wall, running adjacent the contour of the last row of blastholes to be detonated.

In underground operations such as tunnelling, the tunnel face is commonly 4 to 5 metres square and the blastholes are horizontal and drilled into the face. Blastholes at the centre of the face are fired first to provide a void into which the rest of the face can break. The

outermost blastholes which define the contour of the tunnel are the last to be fired.

Optimally, a blast will break rock no further than the contour defined by the perimeter blastholes.

However, often cracks and overbreak caused by the blast extend beyond the perimeter blastholes, into the back and sidewalls of the tunnel. In aboveground applications the overbreak may extend the contour of the last row of boreholes. Overbreak is undesirable because it increases the amount of rock which must be removed after the blast, and adds unnecessarily to cost of the mining operation. Cracks into the back and sidewalls of a tunnel create weakened rock mass which may break out at any time.. This presents a potential major hazard for equipment and personnel. After a blast the tunnel walls have to "scaled" to remove any marginally retained rocks and also mechanical support for the newly exposed rock needs to be installed. Typically, holes are drilled into the sidewalls and backwalls and rock bolts or grouted cables are installed to provide mechanical support. The more cracking and overbreak present, the more the scaling and mechanical support required and the greater the overall cost of the mining operation.

Often cracking and overbreak are corrected by a technique called "perimeter blasting" (also called "trim blasting") carried out along the perimeter of the earlier blast. Perimeter blasting comprises drilling a row of closely-spaced blastholes close to the perimeter of the previous blast. All the holes are charged with light well-distributed charges and are fired simultaneously. The result is a smooth wall with minimal cracking and over break.

The amount and power of explosive used in perimeter blasting is carefully controlled and a number of packaged or cartridged products are available for this purpose. These products are usually highly decoupled, that is, the charges have a diameter significantly smaller than the diameter of the blasthole. Preferably these products have a high velocity of detonation which produces high shock energy and establishes a favourable interhole crack pattern which helps to reduce blast damage beyond the limits of the blastholes.

Cartridged products are supplied with sleeves so that the charges of set lengths can be joined together end to end to form a continuous column of explosive cartridges. Each sleeve comprises a plastic cylinder which fits over adjacent ends of two cartridges, holding the ends of the cartridges in abutment or in sufficiently close proximity that the detonation front travelling along one cartridge will be transmitted to the next. The column of cartridges is held in the blasthole by a retaining device. The retaining device assists in keeping the column of explosive in the blasthole during the extreme rock vibration which occurs prior to the perimeter holes being detonated.

One of the problems of these loading systems is that they require appreciable effort to correctly assemble. Errors is assembly are not uncommon and often ends of adjacent cartridges are not in abutment nor even in close proximity. This may result in incomplete detonation and sections of undetonated cartridge remain in the muckpile of broken rock produced by the explosion.

According to the present invention there is provided a cartridge for an explosive charge wherein said cartridge comprises a shell which defines a chamber for receiving the explosive charge, said cartridge further comprises a first connector means and a second connector means positioned at opposite ends of the shell wherein said first connector means comprises at least one lateral projection and said second connector means comprises a recess adapted to receive a lateral projection on a first connector means of a second cartridge so as to retain the second cartridge substantially coaxial with, and adjacent to, the first mentioned cartridge.

The present invention further provides a cartridged explosive charge wherein said cartridged explosive charge comprises a shell which defines a chamber filled with explosive charge, said cartridged explosive charge further comprises a first connector means and a second connector means positioned at opposite ends of the shell wherein said first connector means comprises at least one lateral projection and said second connector means comprises a recess adapted to receive a lateral projection on a first connector means of a second cartridge so as to retain the second cartridge substantially coaxial with, and adjacent to, the first mentioned cartridge.

The present invention further provides an interconnect means for a cartridged explosive charge wherein said interconnect means comprises a first connector means and a second connector means wherein said first connector means comprises at least one lateral projection and said second connector means comprises a recess adapted to receive a lateral projection on a first connector means of a second cartridge so as to retain the second cartridge substantially coaxial with, and adjacent to, the first mentioned cartridge.

The present invention further provides a method of connecting a plurality of cartridged explosive charges in series wherein each of said cartridged explosive charges comprise a shell which defines a chamber filled with explosive charge, each of said cartridged explosive charges further comprises a first connector means and a second connector means positioned at opposite ends of the shell wherein said first connector means comprises at least one lateral projection and said second connector means comprises a recess adapted to receive a lateral projection on a first connector means of an adjacent cartridged explosive charge, said method comprising engaging the adjacent cartridged explosive charge by inserting the lateral projections into corresponding recesses on the adjacent cartridged explosive charge so as to retain the adjacent cartridged explosive charge substantially coaxial with, and adjacent to, the first mentioned cartridge.

The present invention further provides a method of loading a blasthole with a plurality of cartridged explosive charges wherein said cartridged explosive charges comprise a shell which defines a chamber filled with explosive charge, each of said cartridged explosive charges further comprises a first connector means and a second connector means positioned at opposite ends of the shell wherein said first connector means comprises at least one lateral projection and said second connector means comprises a recess adapted to receive a lateral projection on a first connector means of an adjacent cartridged explosive charge, said method comprising engaging the adjacent cartridged explosive charge by inserting the lateral projections on the first mentioned cartridged explosive charge into the corresponding recesses on the adjacent explosive charge so as to retain the adjacent cartridged explosive charge substantially coaxial with, and adjacent to, the first mentioned cartridge.

The interconnection of cartridged explosives finds particular application in so-called

decoupled blasting applications, that is where a blasthole is larger in diameter than the explosive charge contained therein and the explosive charge is "decoupled" from the wall of the blasthole. For example, the packaged explosive known as TRIMEX (Orica Australia Pty Ltd) is specifically designed for decoupled blasting applications. TRIMEX comprises a long, small diameter packaged explosive in a rigid cartridge, each cartridge about 900mm in length and 19mm in diameter.

Cartridges for use in the present invention preferably comprise a shell which is substantially uniform in cross-section. Preferably the shell is an elongate cylinder. However, the cross-section and length of the shell is not narrowly critical and shells which do not have a circular cross-section, such as cartridges having square, hexagonal or other shaped cross-sections are within the scope of the present invention.

Typically, the shell may be manufactured from plastics material, such as by extrusion or injection moulding. Preferably the shell is an extrusion moulded plastics cylinder. The shell may be manufactured from other materials of construction, for example the shell may be formed from a cardboard cylinder.

The shell defines a chamber for receiving explosive charges. The shell may be sealed at one ind by a plug or bung and subsequently filled with an explosive charge. The other end of the shell may then also be sealed with another plug or bung.

Explosive charges suitable for use in the present invention are preferably liquid or fluid so as to be able to readily fill said chamber. Whilst any liquid or fluid explosive may be suitable, which would include friable powder, it is preferred that the explosive charge is a sensitized water-in-oil emulsion. The cartridge, once filled with the explosive charge will be referred herein to as a "cartridged explosive charge".

The first connector means comprises at least one lateral projection and is positioned at one end of the cartridge. The first connector means may be integral with or affixed to the shell

or cartridge. Preferably the first connector means comprises a sleeve suitable for engagement with the shell or cartridge. The sleeve may fit over the shell or cartridge and engage same with an interference fit, adhesive engagement or other suitable engagement means. The sleeve may also fit within the shell and similarly engage same with an interference fit, adhesive engagement or other suitable engagement means.

The lateral projection or projections may extend either outwardly or inwardly from the first connector means. It is preferred that the first connector means has two diametrically opposed, outwardly extending projections. The projections are preferably tapered at their loading edge to facilitate easy engagement into corresponding recesses and so shaped that once engaged in corresponding recess resist withdrawal.

The second connector means comprises at least one recess adapted to receive a lateral projection on a first connector means of a second cartridge and is positioned at the other end of the cartridge to the first connector means. The second connector means may be integral with or affixed to the shell or cartridge. Preferably the second connector means comprises a sleeve suitable for engagement with the shell or cartridge. The sleeve may fit over the shell or cartridge and engage same with an interference fit, adhesive or other suitable engagement means. The sleeve may also fit within the shell and similarly engage same with an interference fit, adhesive engagement or other suitable engagement means.

The recess or recesses may be an orifice which passes entirely through the second connector means or may be a depression into which the lateral projections may be engaged.

Preferably the first and second connector means comprise sleeves which fit over or into the shell of the cartridge. Preferably, one of the first and second connector means is of slightly smaller diameter and slidably fits inside the other connector means. Both connector means may be partly or entirely hollow cylinders (or of suitable cross-section to engage the shell). However many convenient configurations will be apparent to those skilled in the art to permit one connector means to be slid inside the other.

Preferably the first and second connector means comprise respectively, two projections and two recesses, diametrically opposed. Preferably the recesses are holes of a shape suitable for retaining the projections.

Preferably the projection and/or recess are slightly deformable, so that during assembly, either the projection or the recess deform, but spring back to normal shape when the projection is located in the recess.

Alternatively the projection and recess may comprise what is often called a bayonet fitting, that is a projection comprising a simple post, and a recess comprising an L-shaped pathway, such that during assembly, the post is slid along the pathway to the end of the L and retained therein.

Preferably, the first and second connector means may each incorporate a diaphragm and be used to seal the cartridge and eliminate the need for separate plugs or bungs in tubular chambers as described above.

It will be understood that the phrase "so as to retain the second (or adjacent) cartridge substantially coaxial with and adjacent to, the first mentioned cartridge" is a practical phrase and requires that the ends of adjacent cartridges are held in close proximity, that is, sufficiently close that a detonation front passing along one explosive cartridge will be transmitted from the end of one explosive cartridge to the adjacent end of another explosive cartridge. Preferably the ends adjacent cartridges are retained in abutment.

In a preferred embodiment of the present invention one or both of the first and second connector means include a positioning means for retaining the cartridged explosive charges in position in the blasthole. The positioning means may be integral with the first and/or second connector means prior to loading into the blasthole. In an alternative configuration, the positioning means may engage with the shell of the cartridge.

The positioning means may preferably comprise a collar for engagement with the first and/or second connector means. A plurality of legs extend outwardly from the collar and are adapted to engage with the wall of the blasthole.

The collar may preferably engage the first and/or second connector means and be retained thereon by a locating means. Preferably the locating means comprises a pair of tabs separated by the width of the collar of the positioning means. Preferably the locating means are shaped such that a circular collar may be slid over one locating means but thereafter cannot be readily removed from between the pair of locating means.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

The present invention will be further described with reference to the drawings wherein;

Figure 1 is a plan view of the first connector means of the present invention;

Figure 2 is a plan view of the first connector means of the present invention;

Figure 3 is a perspective view of positing means of one embodiment of the present invention;

Figure 4 is a plan view of the first and second connector means lined up for engagement.

Figure 5 is a plan view of the device of the present invention located in a vertical blasthole in a mine bench.

Figure 1 shows a first connector means (1) retained by interference fit into the shell (5) of a first cartridge explosive (20). The first connector means (1) comprises a hollow tube (2)

which is of slightly lesser diameter shell (5) of the first cartridge of explosive (20). The first connector means (1) has been inserted into the shell (5). The diaphragm (4) seals the end of the shell (5) so as to retain the explosive within the explosive cartridge (20). The first connecting means (1) has two outwardly directed projection (3).

Figure 2 shows a second connector means (6) which is engaged by interference fit with the other end of the shell (5) of the first cartridge of explosive (20). The outer sleeve (7) of the first connector means (1) is slightly greater in diameter than the external diameter of shell (5). The second connector means (6) further incorporates an inner sleeve (8) which is of slightly lesser diameter than the internal diameter of the shell (5). The shell (5) is in interference fit between the outer sleeve (7) and the inner sleeve (8). The second connector means (6) is provided with a diaphragm (9) which acts to seal the explosive in the shell (5) to form the first cartridge of explosive (20). The second connector means (6) further comprises a sleeve (10) for engagement with the first connector means (1), shown in figure 1. The sleeve (10) incorporates recess (11) for engagement with the projections (3) of the first connector means (1). The second connector means (6) further comprises locating lugs (12) and (13) which will be described further in relation to figure 4.

Figure 3 shows a positioning means which comprises a collar (15) for slideable engagement with the second connector means (6) and fixed engagement between the lugs (12) and (13). The positioning means (14) includes a number of outwardly projecting legs (16) having feet (17) and which are shaped (18) for engagement with the wall of the borehole. The collar (15) include an expansion means (19) which facilitates the collar sliding over the pair of lugs (12).

Figure 4 shows a first cartridge of explosive (20) to which is attached a first connector means (1), and a second cartridge of explosive (21) to which is attached a second connector means (6). The first connector means (1) comprises a hollow cylinder (2) which has an external diameter slightly smaller than internal diameter of the first cartridge (20) and which is held in the end of the first cartridge (20) by interference fit. The first connector means (1) has a diaphragm which seals the tube (5) of the first cartridge (20). The first connector means (1)

has two projections (3) which project outward and backward from the external wall of the first connector means (1). The second connector means (6) also comprises a hollow cylinder (7) which has an internal diameter slightly larger than the external diameter of the second cartridge (21). The second connector means (6) is held on the end of the second cartridge (21) by interference fit. The second connector means (6) comprises a pair of recesses in the form of holes (11). During assembly the first connector means (1) is slid inside the sleeve (10 ) of the second connector means (6), deforming the projections (3) until the projections reach the recesses (11) and spring back into shape, thus holding the first and second connector means in contact. The second connector means (6) further comprises two pairs of locating lugs (12) and (13) on the external wall. A positioning means (14), comprising a collar (15) and multiple projections (16) projecting downwards and outwards from one edge of the collar (15) may be slid over the second connector means (6) until it is located between the two pairs of lugs (12) and (13). The lugs (12) and (13) are shaped so as to permit sliding of the collar (15) to a position between the two pairs of lugs (12) and (13), but resist subsequent sliding removal of the retaining piece from the second connector piece.

Figure 5 depicts a mine bench (30) and mine wall (31) which have been formed as a result of a primary blast. The outline of the mine bench before the primary blast is indicated by dots (33). The positions of the rows of blastholes in the mine bench before primary blast are indicated by dashes (34). The primary blast has caused damage to the bench face (31) extending beyond the primary blasthole (34a) leaving the bench face (31) uneven, deeply cracked and pitted such that the bench face is unstable and proceed to crumbling. The damaged rock or ore can be removed to provide a smooth vertical bench face by perimeter blasting. Accordingly a row of closely spaced 40mm diameter blastholes (39) have been drilled parallel with the damaged bench face and have been loaded with multiple 19mm diameter cartridges. The cartridges have been connected together using the connectors according to the present invention to form a continuous column (40) of explosives in each blasthole. Retaining pieces (45) have been attached to every second connector of the column to maintain the column in the blasthole. A detonator located in the column of explosive can be used to initiate a detonation throughout the column. The resulting detonation removes the

narrow berm left in place after the primary blast and provides a smooth, vertical bench face.

CLAIMS

1. A cartridge for an explosive charge wherein said cartridge comprises a shell which defines a chamber for receiving the explosive charge, said cartridge further comprises a first connector means and a second connector means positioned at opposite ends of the shell wherein said first connector means comprises at least one lateral projection and said second connector means comprises a recess adapted to receive a lateral projection on a first connector means of a second cartridge so as to retain the second cartridge substantially coaxial with, and adjacent to, the first mentioned cartridge.

2. A cartridge according to claim 1 wherein the first connector means comprises a sleeve adapted to engage the shell by an interference fit.

3. A cartridge according to claim 1 wherein the first connector means comprises two diametrically opposed, outwardly extending projections.

4. A cartridge according to claim 1 wherein the first connector means comprises a diaphragm for sealing the end of the shell.

5. A cartridge according to claim 1 wherein the second connector means comprises a sleeve adapted to engage the shell by an interference fit.

6. A cartridge according to claim 1 wherein the second connector means comprises two diametrically opposed recesses.

7. A cartridge according to claim 1 wherein the second connector means comprises a diaphragm for sealing the end of the shell.

8. A cartridge according to claim 1 wherein the at least one recess is adapted to retain the second cartridge in abutment with the first mentioned cartridge.

9. A cartridge according to claim 1 wherein one or both of the first and second connector mean include positioning means include a positioning means for retaining the cartridged explosive charges in position in the blasthole.

10. A cartridge according to claim 9 wherein the positioning means comprises a collar for engagement with the first and/or second connector means and a plurality of legs extend outwardly from the collar and are adapted to engage with the wall of the blasthole.

11. A cartridge according to claim 10 wherein the collar is retained by locating means which comprises a pair of lugs separated by the width of the collar of the positioning means.

12. A cartridged explosive charge wherein said cartridged explosive charge comprises a shell which defines a chamber filled with explosive charge, said cartridged explosive charge further comprises a first connector means and a second connector means positioned at opposite ends of the shell wherein said first connector means comprises at least one lateral projection and said second connector means comprises a recess adapted to receive a lateral projection on a first connector means of a second cartridge so as to retain the second cartridge substantially coaxial with, and adjacent to, the first mentioned cartridge.

13. A cartridged explosive charge according to claim 12 wherein the first connector means comprises a sleeve adapted to engage the shell by an interference fit.

14. A cartridged explosive charge according to claim 12 wherein the first connector means comprises two diametrically opposed, outwardly extending projections.

15. A cartridged explosive charge according to claim 12 wherein the first connector means comprises a diaphragm for sealing the end of the shell.

16. A cartridged explosive charge according to claim 12 wherein the second connector means comprises a sleeve adapted to engage the shell by an interference fit.

17. A cartridged explosive charge according to claim 12 wherein the second connector means comprises two diametrically opposed recesses.

18. A cartridged explosive charge according to claim 12 wherein the second connector means comprises a diaphragm for sealing the end of the shell.

19. A cartridged explosive charge according to claim 12 wherein the at least one recess is adapted to retain the second cartridge in abutment with the first mentioned cartridge.

20. A cartridged explosive charge according to claim 12 wherein one or both of the first and second connector mean include positioning means include a positioning means for retaining the cartridged explosive charges in position in the blasthole.

21. A cartridged explosive charge according to claim 20 wherein the positioning means comprises a collar for engagement with the first and/or second connector means and a plurality of legs extend outwardly from the collar and are adapted to engage with the wall of the blasthole.

22. A cartridged explosive charge according to claim 21 wherein the collar is retained by locating means which comprises a pair of lugs separated by the width of the collar of the positioning means.

23. An interconnect means for a cartridged explosive charge wherein said interconnect means comprises a first connector means and a second connector means wherein said first connector means comprises at least one lateral projection and said second connector means comprises a recess adapted to receive a lateral projection on a first connector means of a second cartridge so as to retain the second cartridge substantially coaxial with, and adjacent to, the first mentioned cartridge.

24. An interconnect means for a cartridged explosive charge according to claim 23 wherein

the first connector means comprises a sleeve adapted to engage the shell by an interference fit.

25. An interconnect means for a cartridged explosive charge according to claim 23 wherein the first connector means comprises two diametrically opposed, outwardly extending projections.

26. An interconnect means for a cartridged explosive charge according to claim 23 wherein the first connector means comprises a diaphragm for sealing the end of the shell.

27. An interconnect means for a cartridged explosive charge according to claim 23 wherein the second connector means comprises a sleeve adapted to engage the shell by an interference fit.

28. An interconnect means for a cartridged explosive charge according to claim 23 wherein the second connector means comprises two diametrically opposed recesses.

29. An interconnect means for a cartridged explosive charge according to claim 23 wherein the second connector means comprises a diaphragm for sealing the end of the shell.

30. An interconnect means for a cartridged explosive charge according to claim 23 wherein the at least one recess is adapted to retain the second cartridge in abutment with the first mentioned cartridge.

31. An interconnect means for a cartridged explosive charge according to claim 23 wherein one or both of the first and second connector mean include positioning means include a positioning means for retaining the cartridged explosive charges in position in the blasthole.

32. An interconnect means for a cartridged explosive charge according to claim 31 wherein the positioning means comprises a collar for engagement with the first and/or second

connector means and a plurality of legs extend outwardly from the collar and are adapted to engage with the wall of the blasthole.

33. An interconnect means for a cartridged explosive charge according to claim 32 wherein the collar is retained by locating means which comprises a pair of lugs separated by the width of the collar of the positioning means.

34. A method of connecting a plurality of cartridged explosive charges in series wherein each of said cartridged explosive charges comprise a shell which defines a chamber filled with explosive charge, each of said cartridged explosive charges further comprises a first connector means and a second connector means positioned at opposite ends of the shell wherein said first connector means comprises at least one lateral projection and said second connector means comprises a recess adapted to receive a lateral projection on a first connector means of an adjacent cartridged explosive charge, said method comprising engaging the adjacent cartridged explosive charge by inserting the lateral projections into corresponding recesses on the adjacent cartridged explosive charge so as to retain the adjacent cartridged explosive charge substantially coaxial with, and adjacent to, the first mentioned cartridge.

35. A method of connecting a plurality of cartridged explosive charges in series according to claim 34 wherein the first connector means comprises a sleeve adapted to engage the shell by an interference fit.

36. A method of connecting a plurality of cartridged explosive charges in series according to claim 34 wherein the first connector means comprises two diametrically opposed, outwardly extending projections.

37. A method of connecting a plurality of cartridged explosive charges in series according to claim 34 wherein the first connector means comprises a diaphragm for sealing the end of the shell.

38. A method of connecting a plurality of cartridged explosive charges in series according

to claim 34 wherein the second connector means comprises a sleeve adapted to engage the shell by an interference fit.

39. A method of connecting a plurality of cartridged explosive charges in series according to claim 34 wherein the second connector means comprises two diametrically opposed recesses.

40. A method of connecting a plurality of cartridged explosive charges in series according to claim 34 wherein the second connector means comprises a diaphragm for sealing the end of the shell.

41. A method of connecting a plurality of cartridged explosive charges in series according to claim 34 wherein the at least one recess is adapted to retain the second cartridge in abutment with the first mentioned cartridge.

42. A method of connecting a plurality of cartridged explosive charges in series according to claim 34 wherein one or both of the first and second connector mean include positioning means include a positioning means for retaining the cartridged explosive charges in position in the blasthole.

43. A method of connecting a plurality of cartridged explosive charges in series according to claim 42 wherein the positioning means comprises a collar for engagement with the first and/or second connector means and a plurality of legs extend outwardly from the collar and are adapted to engage with the wall of the blasthole.

44. A method of connecting a plurality of cartridged explosive charges in series according to claim 43 wherein the collar is retained by locating means which comprises a pair of lugs separated by the width of the collar of the positioning means.

45. A method of loading a blasthole with a plurality of cartridged explosive charges wherein

said cartridged explosive charges comprise a shell which defines a chamber filled with explosive charge, each of said cartridged explosive charges further comprises a first connector means and a second connector means positioned at opposite ends of the shell wherein said first connector means comprises at least one lateral projection and said second connector means comprises a recess adapted to receive a lateral projection on a first connector means of an adjacent cartridged explosive charge, said method comprising engaging the adjacent cartridged explosive charge by inserting the lateral projections on the first mentioned cartridged explosive charge into the corresponding recesses on the adjacent explosive charge so as to retain the adjacent cartridged explosive charge substantially coaxial with, and adjacent to, the first mentioned cartridge.

46. A method of loading a blasthole with a plurality of cartridged explosive charges according to claim 45 wherein the first connector means comprises a sleeve adapted to engage the shell by an interference fit.

47. A method of loading a blasthole with a plurality of cartridged explosive charges according to claim 45 wherein the first connector means comprises two diametrically opposed, outwardly extending projections.

48. A method of loading a blasthole with a plurality of cartridged explosive charges according to claim 45 wherein the first connector means comprises a diaphragm for sealing the end of the shell.

49. A method of loading a blasthole with a plurality of cartridged explosive charges according to claim 45 wherein the second connector means comprises a sleeve adapted to engage the shell by an interference fit.

50. A method of loading a blasthole with a plurality of cartridged explosive charges according to claim 45 wherein the second connector means comprises two diametrically opposed recesses.

51. A method of loading a blasthole with a plurality of cartridged explosive charges

according to claim 45 wherein the second connector means comprises a diaphragm for sealing the end of the shell.

52. A method of loading a blasthole with a plurality of cartridged explosive charges according to claim 45 wherein the at least one recess is adapted to retain the second cartridge in abutment with the first mentioned cartridge.

53. A method of loading a blasthole with a plurality of cartridged explosive charges according to claim 45 wherein one or both of the first and second connector mean include positioning means include a positioning means for retaining the cartridged explosive charges in position in the blasthole.

54. A method of loading a blasthole with a plurality of cartridged explosive charges according to claim 53 wherein the positioning means comprises a collar for engagement with the first and/or second connector means and a plurality of legs extend outwardly from the collar and are adapted to engage with the wall of the blasthole.

55. A method of loading a blasthole with a plurality of cartridged explosive charges according to claim 54 wherein the collar is retained by locating means which comprises a pair of lugs separated by the width of the collar of the positioning means.

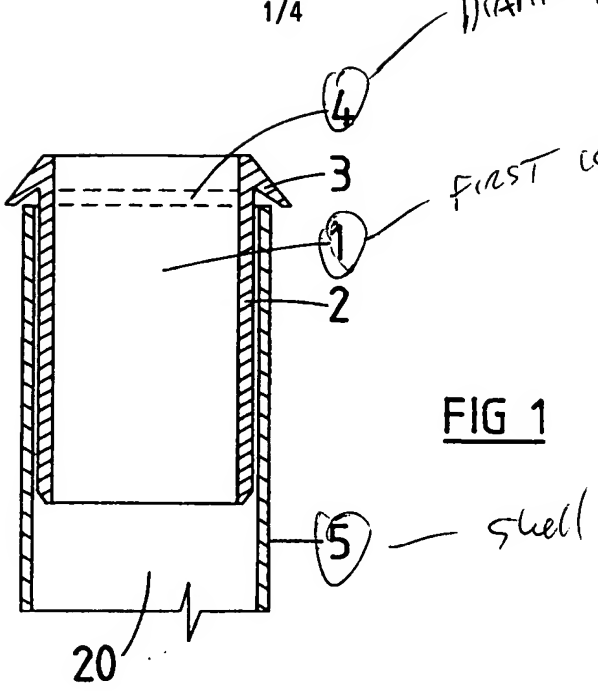

DIAPHRAGM
4
3
FIRST CONNECTOR MEANS
1
2
5
SHELL
20

FIG 1

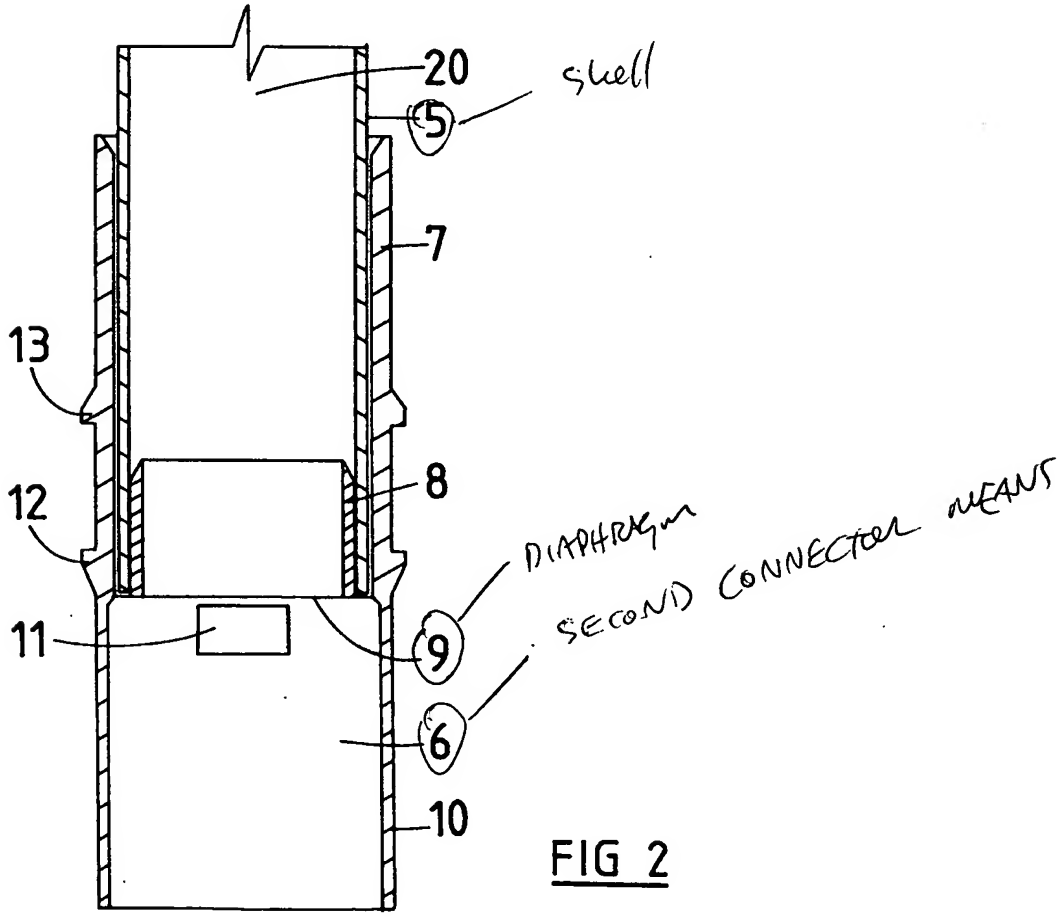

20
SHELL
5
7
13
8
12
DIAPHRAGM
SECOND CONNECTOR MEANS
11
9
6
10

FIG 2

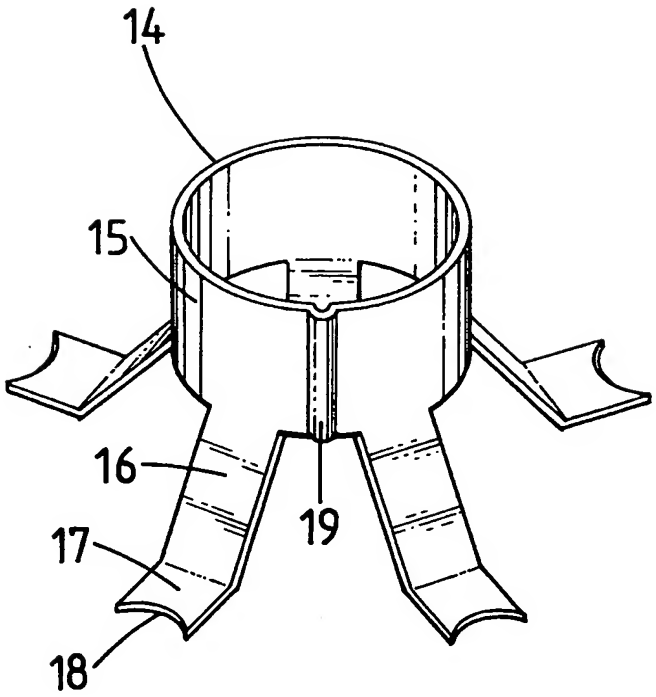



FIG 3

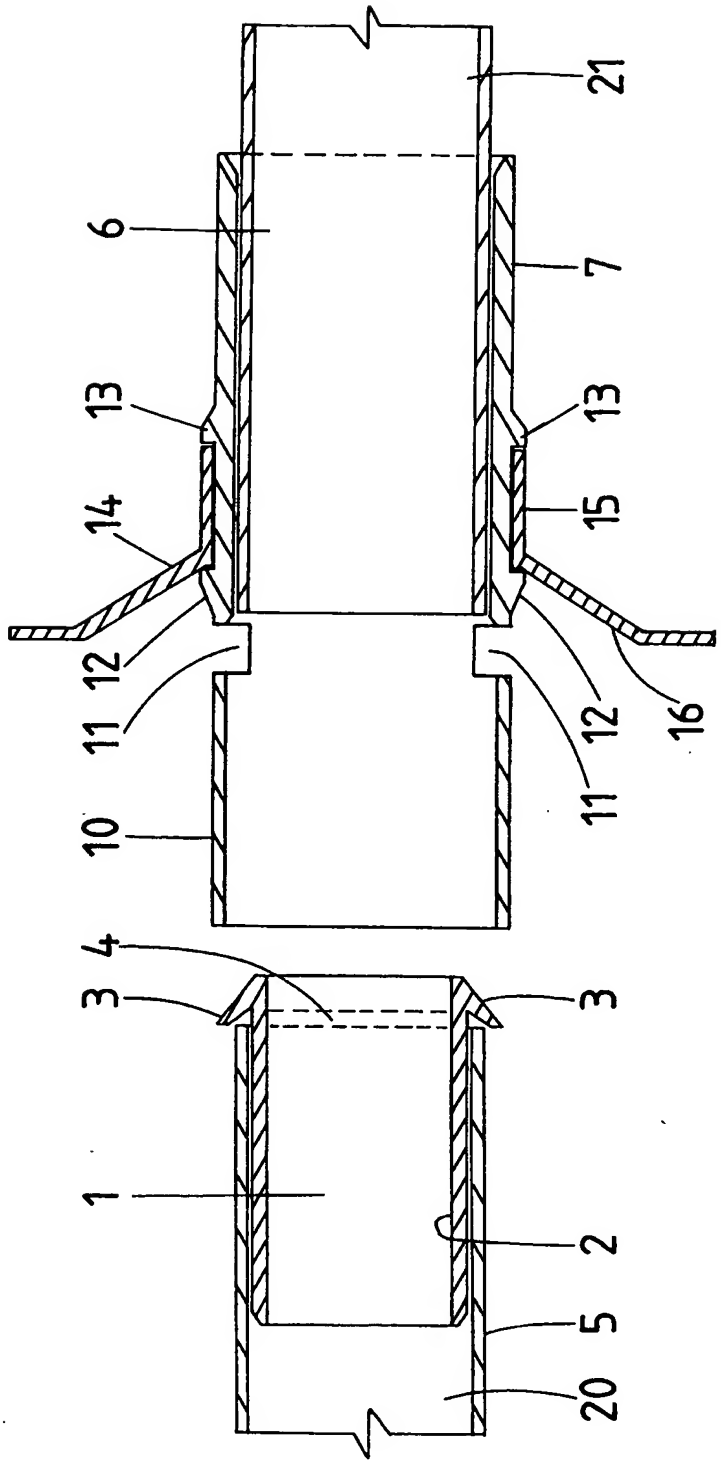
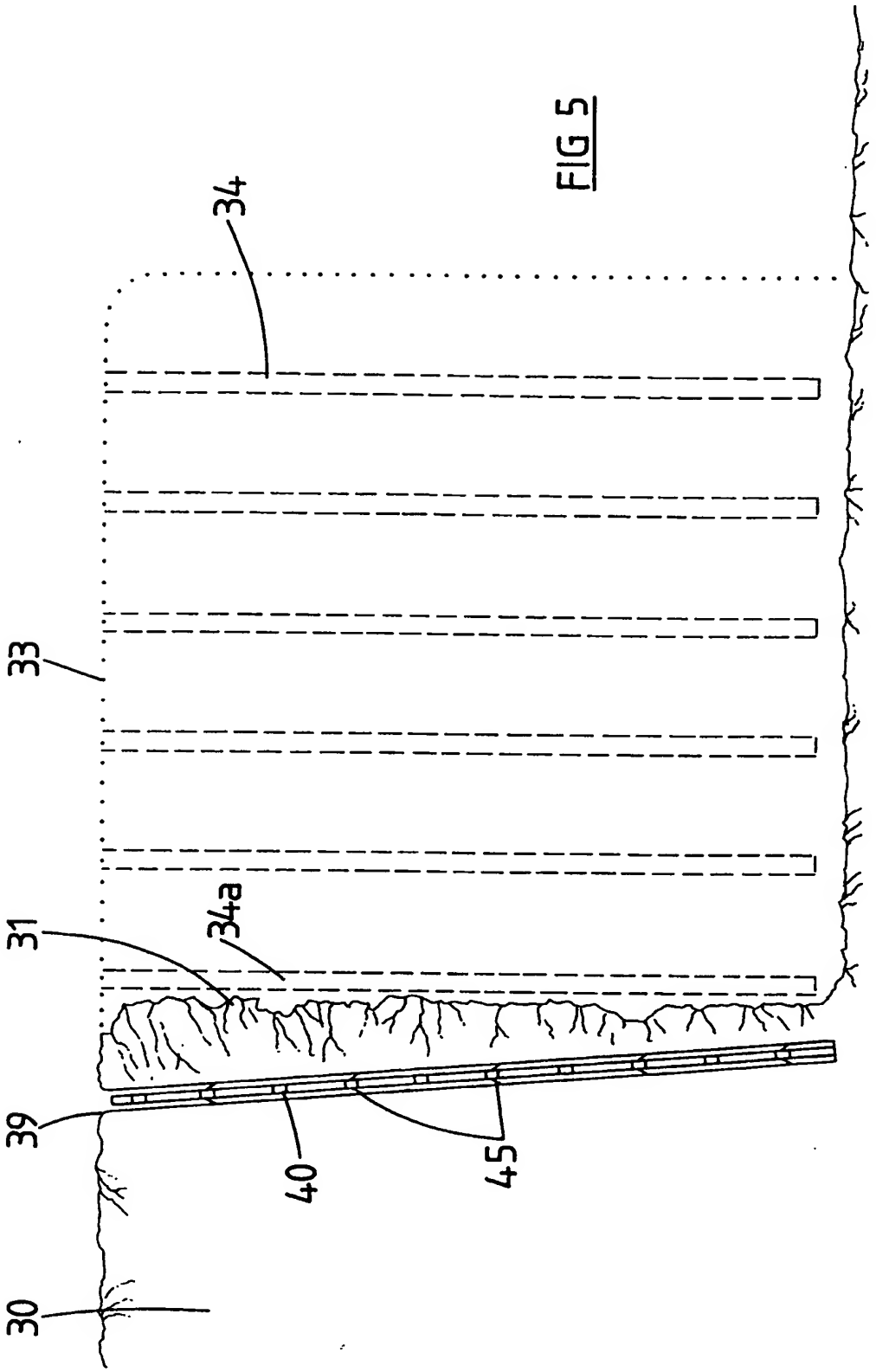



FIG 4

FIG 5



**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/AU 99/00146

**A. CLASSIFICATION OF SUBJECT MATTER**

Int Cl[6]: F42B 3/02, 3/00, 5/38, F42D 1/02

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)
IPC: F42B 3/02, 3/00, 5/38, F42D 1/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT: Keywords

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X, Y | EP 0691520 A (GIAT INDUSTRIES) 10 January 1996<br>Column 5 line 49 to column 7 line 27, claims 3, 9 & 12, figures 1-7 | 1-55 |
| Y | AU 52834/79 (525543) B (IMPERIAL CHEMICAL INDUSTRIES LIMITED) 24 July 1980<br>Whole document | 1-55 |
| Y | WO 94/08198 A (POLLOCK) 14 April 1994<br>Whole document. | 1-55 |

☐ Further documents are listed in the continuation of Box C

☒ See patent family annex

* Special categories of cited documents:

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"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 6 April 1999 | 20 APR 1999 |
| Name and mailing address of the ISA/AU<br>AUSTRALIAN PATENT OFFICE<br>PO BOX 200<br>WODEN ACT 2606<br>AUSTRALIA<br>Facsimile No.: (02) 6285 3929 | Authorized officer<br><br>LIONEL BOPAGE<br>Telephone No.: (02) 6283 2153 |

# INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
**PCT/AU 99/00146**

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

| Patent Document Cited in Search Report | | Patent Family Member | | | | | |
|---|---|---|---|---|---|---|---|
| EP | 0691520 | FR | 2721375 | US | 5607057 | | |
| AU | 52834/79 | BR | 8000202 | CA | 1146803 | EP | 13473 |
| | | GB | 2040412 | IN | 154008 | JP | 55096899 |
| | | NO | 793694 | NZ | 192097 | ZA | 7906064 |
| | | ZW | 225/79 | | | | |
| WO | 94/08198 | EP | 616682 | US | 5435250 | | |

END OF ANNEX